CALCULATION OF CEMENT FILL AND WELL VOLUMES

Facility Name	USEPA Permit Number	State Permit Number	Well Class
Lanphar 1-12	MI-125-2R-0030	32168	2R

Well Name	State	County	Analyst
Lanphar 1-12	Michigan	Oakland	A. Miller

Operator	Township	Range	Section	Analysis Date
Energex Petroleim Corp	5N	11E	12	August 20, 2015

Geological Information		Completion Information			
Name of Lowermost USDW	Base of USDWs, ft	Total Depth, ft	Top of Perfs, ft		
Glacial Drift	362		4156		
Formations in Inj. Zone	Top of Inj. Zone, ft	Packer Depth, ft	Packer Depth OK?		
Niagaran Geulph	3988	4050	YES		

EVALUATION OF WELL CONSTRUCTION

		CASING STRING			
		Surface Casing	Casing 3	Long String	
Top of Casing		0	0	0	0
Bottom of Casing		567	2532	4305	
Well Bore Diameter		15	11	7.875	
Outside Diameter of Casing		11.75	8.625	5.5	
Weight per Foot of Casing		38	20	15.5	
1st Stage Cement					
Cu Ft to Fill Annulus in Open Hole		322.6	599.4	368.6	
Cu Ft to Fill Annulus in Cased Hole			154.4	508.7	
Cement/Epoxy Used		550	200	150	
Average Yield		1.18	1.18	1.18	
Top of Cement in Annulus		0	1758	3380	
2nd Stage Cement				(per bond log)	
Depth of DV Tool					
Cu Ft to Fill Annulus in Open Hole					
Cu Ft to Fill Annulus in Cased Hole					
Sacks of Cement Used					
Average Yield					
Top of Cement in Annulus					
3rd Stage Cement					
Depth of DV Tool					
Cu Ft to Fill Annulus in Open Hole					
Cu Ft to Fill Annulus in Cased Hole					
Sacks of Cement Used					
Average Yield					
Top of Cement in Annulus					
Meets Standards for Surface Casing		YES	NO-cement	NO-cement	
Meets Standards for Any Casing		YES	YES	YES	
Meets Standards for Protection Casing		NO-casing	NO-casing	YES	

Comments

Used 11.75 @ 38# and 8.625@ 20#

CALCULATION OF CEMENT FILL AND WELL VOLUMES

Facility Name	USEPA Permit Number		State Permit Number		Well Class
Lanphar 2-12			32366		producer
Well Name	State	County		Analyst	
AOR WELL	Michigan	Oakland		A. Miller	
Operator	Township	Range	Section	Analysis Date	
	5N	11E	12	September 3, 2015	

Geological Information		Completion Information			
Name of Lowermost USDW	Base of USDWs, ft	Total Depth, ft	Top of Perfs, ft		
Glacial Drift	362	4425			
Formations in Inj. Zone	Top of Inj. Zone, ft	Packer Depth, ft	Packer Depth OK?		
Niagaran Geulph	4220				

EVALUATION OF WELL CONSTRUCTION

	CASING STRING				
	Surface Casin	Casing 2	Long String		
Top of Casing	?	0	0	0	0
Bottom of Casing	496	2552	4411		
Well Bore Diameter	13.75	10.625	7.5		
Outside Diameter of Casing	11.75	8.625	5.5		
Weight per Foot of Casing	38	20	15.5		
1st Stage Cement					
Cu Ft to Fill Annulus in Open Hole	165.6	518.1	316.3		
Cu Ft to Fill Annulus in Cased Hole		135.0	512.7		
Cement/Epoxy Used	300	175	175		
Average Yield	1.18	1.18	1.18		
Top of Cement in Annulus	0	1732	3198		
2nd Stage Cement					
Depth of DV Tool					
Cu Ft to Fill Annulus in Open Hole					
Cu Ft to Fill Annulus in Cased Hole					
Sacks of Cement Used					
Average Yield					
Top of Cement in Annulus					
3rd Stage Cement					
Depth of DV Tool					
Cu Ft to Fill Annulus in Open Hole					
Cu Ft to Fill Annulus in Cased Hole					
Sacks of Cement Used					
Average Yield					
Top of Cement in Annulus					
Meets Standards for Surface Casing	YES	NO-cement	NO-cement		
Meets Standards for Any Casing	YES	YES	YES		
Meets Standards for Protection Casing		NO-casing	YES		

Comments

Used 2" hole, and conservative/common casing wt/f since not found in files.

CALCULATION OF CEMENT FILL AND WELL VOLUMES

Facility Name	USEPA Permit Number	State Permit Number	Well Class
Lanphar 7-12		39257	producer

Well Name	State	County	Analyst
AOR WELL	Michigan	Oakland	A. Miller

Operator	Township	Range	Section	Analysis Date
	5N	11E	12	September 3, 2015

Geological Information		Completion Information			
Name of Lowermost USDW	Base of USDWs, ft	Total Depth, ft	Top of Perfs, ft		
Glacial Drift	362	4355	4090		
Formations in Inj. Zone	Top of Inj. Zone, ft	Packer Depth, ft	Packer Depth OK?		
Niagaran Geulph	3988				

EVALUATION OF WELL CONSTRUCTION

	CASING STRING				
	Surface Casin	Casing 2	Long String		
Top of Casing		0	0	0	0
Bottom of Casing	497	2571	4390		
Well Bore Diameter	13.75	10.625	7.5		
Outside Diameter of Casing	11.57	8.625	5.5		
Weight per Foot of Casing	42	24			
1st Stage Cement					
Cu Ft to Fill Annulus in Open Hole	179.5	522.6	309.5		
Cu Ft to Fill Annulus in Cased Hole		-201.7	494.9		
Cement/Epoxy Used	310	200	250		
Average Yield	1.18	1.18	1.18		
Top of Cement in Annulus	0	1634	2656		
2nd Stage Cement					
Depth of DV Tool					
Cu Ft to Fill Annulus in Open Hole					
Cu Ft to Fill Annulus in Cased Hole					
Sacks of Cement Used					
Average Yield					
Top of Cement in Annulus					
3rd Stage Cement					
Depth of DV Tool					
Cu Ft to Fill Annulus in Open Hole					
Cu Ft to Fill Annulus in Cased Hole					
Sacks of Cement Used					
Average Yield					
Top of Cement in Annulus					
Meets Standards for Surface Casing	YES	NO-cement	NO-cement		
Meets Standards for Any Casing	YES	YES	YES		
Meets Standards for Protection Casing		NO-casing	YES		

Comments

Comments in this cell

CALCULATION OF WELL-SPECIFIC PRESSURE EFFECTS

Facility Name		Operator	
Lanphar 1-12		Energex Petroleim Corp	
Well Name		**USEPA Permit Number**	**State Permit Number**
Lanphar 1-12		MI-125-2R-0030	
County	**State**	**Well Class**	**Analyst**
Oakland	Michigan	2R	A. Miller
Township	**Range**	**Section**	**Date**
5N	11E	12	13-Jul-16

JUSTIFICATION FOR FRACTURE GRADIENT

Administrative Basis for Fracture Gradient	Field Name
Code of Federal Regulatiions § 147.1152(b)	NA
Site-specific Testing Basis for Fracture Gradient	

Source of Fracture Gradient	Well Name	Test Date	Fracture Gradient
default			**0.80**

MAXIMUM INJECTION PRESSURE		PRESSURE LOSS TO FRICTION	
Fracture gradient, psi/ft	Type of Fluid, liquid or gas	Maximum Injection Rate, gpm	Viscosity of injectate, cp.
0.80	gas	0	0.0
Top of Inj. Zone, ft	100	Diameter of the Tubing, in.	Average velocity of injection, ft/sec
3988		0.000	
Specific Gravity		Weight of Tubing, lbs/ft	Reynolds Number
0.765		0.000	
Safety factor	**Maximum Injection Pressure, psi**	Internal Diameter of Tubing, ins	Total Friction Loss, psi
0.05	**2866**	0.000	

INFORMATION FOR CALCULATING PRESSURE CHANGE

Total Volume of Well (tubing and Open Hole), gals	Total Volume of Annulus, gals
255	4047
Predicted Well Bore Storage, gals/psi	**Additional Volume to Increase Pressure by 100 psi, gals**
0.007	0.12

For gas injection, the maximum allowable injection pressure was calculated in accordance with the UIC Branch Standard Operating Procedure for Calculating Maximum Injection Pressure, SOP-WD-UIC-24, May 2010, using the formula below:

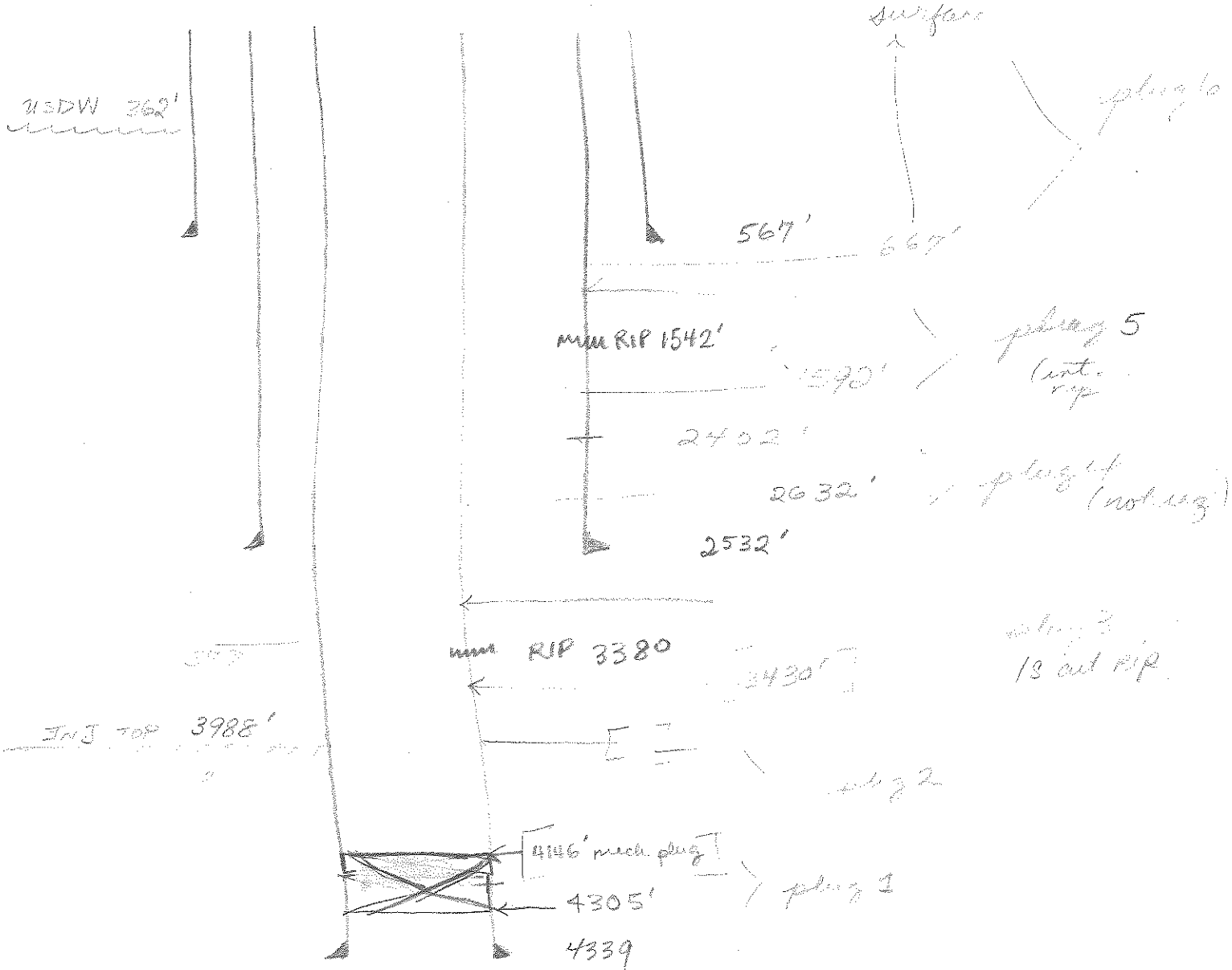
3.8 For wells injecting gas in a gaseous state (not compressed to a liquid or supercritical), use the following equation (Rawlins and Schellhardt, 1936):

$$MIP = FG \times D_{TZT} \times e^{\left(SG \times D_{TZT} / 53.34 \times (460+T)\right)} - 14.7 \qquad \text{Eq. 13}$$

Where:
SG = Specific Gravity of the gas (dimensionless, air = 1.00)
T = Average temperature in the wellbore (°F)

FG = fracture gradient

D = depth



LEAST # SACKS TO MEET REQs

plug 1 $\frac{(4305 - 4146)' \times 1}{(1.18\ ft^3/sk)(7.483\ ft^3/ft^3)}$ = 18 sacks

plug 2 = ~~$\frac{(3988 - 3738)}{(1.18\ ft^3/sk)}$~~ 250^{neg} = 28 sacks for 250 ft ✓

plug 3 (rip pt) = $\frac{(3430' - 3390')}{(1.18)(7.483)} + \frac{(3380 - 3330)^{neg}(1.2)}{(1.18)(2.9365)}$ = 11 + 17 = 28 sacks for rip pt ✓

pl. 4 not neg N/A

pl 5 $\frac{(1590 - 1542)'\ 50}{(1.18)(2.733\ ft^3/ft^3)} + \frac{50\ (1542 - 1492)^{neg}(1.2)}{(1.18)(1.5155\ ft^3/ft^3)}$ = 15 + 33 = 48 sks for ext rip ✓

plug 6 $\dfrac{(667-0)\,ft}{(1.18\,ft^3/sk)(1.4715\,ft/ft^3)} =$ at least 383 sks for USDW – surface ✓

	calculated tent # sacks	# sacks in plan
plug 1	18	50 ✓
plug 2	28	32 ✓
plug 3	28	60 ✓
plug 4 (Not Req.)	—	—
plug 5	48	100 ✓
plug 6	383	404 ✓

✓ plan cement sacks exceeds calc. required cement sks